Refurbishing a Clansman Battery

Colin Guy G4DDI

New battery packs are available for the Clansman radios, (eg www.milpower.co.uk) but they are serious money. Used packs are readily available, but being NiCads, they are likely to have a very limited life and reduced capacity.

The one I obtained also exhibited a strange effect in that it would charge up and give the correct 24V terminal voltage, but if left on the shelf the voltage would fall quite suddenly after a few minutes to around 20V, and the battery would heat up quite noticeably, suggesting an internal short.

Measurement of the pack suggested that it's internal dimensions were five 'D' cells by two 'D' cells by two 'D' cells: 5x2x2=20, each Ni-Cad 'D' cell is 1.2 volts: 20x1.2=24, the required voltage, so I decided to see if was is possible to dismantle the battery pack.

Firstly, though, a word on charging NiCad batteries. A very good description of the internal workings of these batteries is given at http://www.wppltd.demon.co.uk/WPP/Batteries/Chemistry/chemistry.html . Suffice it to say here that they have to be charged from a constant current source; the normal rate is 1/10 th of the Ah capacity of the cell. The Clansman batteries vary between about 3 and 5 Ah, depending on the age and manufacturer of the battery, so for say a 3.5 Ah battery, the charging rate would be 350mA. At this rate it would take a theoretical 10 hours to fully charge a flat battery, in practice it takes 14 hours due to losses. Once the battery is fully charged, an internal process prevents damage to the battery should charging continue at this rate. Clearly, however, it is impractical in many situations to wait for 14 hours to charge a battery, imagine having to do this from a hand generator for instance!

However, it is possible to charge a battery in a much shorter time by using a higher charging current, and this will not harm the battery whilst it is charging. However, once fully charged the battery cannot store any more energy and the excess is dissipated as heat, and causes damage to the cell, and releases hydrogen and oxygen with possible serious consequences. Whilst charging at these higher currents, the battery remains substantially at room temperature but once fully charged a substantial rise in temperature occurs.

The Clansman chargers appear to operate at about 1.5A charging current, and will therefore charge a 3.5 Ah battery in about 2½ hours. To prevent damage to the battery by overcharging a method of detecting the temperature rise is needed. In the Clansman battery are two temperature sensors, which are in fact silicon diodes. One is embedded amongst the cells in the pack, and one is mounted close to the metal casing. The latter detects the ambient temperature and when the embedded diode senses a higher temperature the charger is signalled that the battery is fully charged and the lamps on the charger change from 'proceeding' to 'complete'. Fig 5 shows the wiring of the charger connector on the battery pack.

Rebuilding the Battery.

As stated above, the Clansman 24 volt battery requires 20 'D' cells. These vary in price, but you do get what you pay for to some extent. They are also available in various capacities. The best compromise I found was to buy 2.4 volt batteries intended for emergency lighting units. These 4.5Ah units consist of two 'D' cells in-line, in a shrink-wrap, and cost £6.88 each from CPC at Preston (www.cpc.co.uk) It is possible that they may be cheaper from other sources of course. You will require 10 of these, so the cost is approaching £70, but I think it worthwhile if you are seriously keen on going out /p! If you really want to push the boat out, a 7Ah 'D' cell is available for £8.17 *per cell!*

First, make sure the battery is fully discharged then begin by carefully drilling out the pop rivets holding the metal top of the case in place and ease the top away. You will find a thin fibreglass insulating layer beneath it, peel this away to reveal the top layer of cells, embedded in that horrible expanding foam material. Carefully pick this away with a small screwdriver around one or two cells in the centre of the pack, taking care not to damage the cells unduly. If, as I did, you find evidence that the cells have leaked, take personal

Fig.1 The top layer of cells removed

protection precautions as small amounts of Potassium Hydroxide may have been released, and this is highly poisonous. Eventually you should be able to loosen the cells and extract the top layer one by one, twisting them gently to break the connections, then do the same for the bottom layer. At some point you should come across a pair of thin wires inside a piece of plastic sleeving, this is the diode sensor: take great care not to damage this, it will need to be replaced afterwards. When all the cells are out, clean out the remaining foam from the sides and bottom of the casing. There is no need to remove the foam from the area beneath the connecting terminals: there is another sensing diode embedded in this area which could easily be damaged. You should be left with a red and a black wire, as well as the sensor described above, which disappear into the remaining foam around the connectors, these are of course the positive

Fig.2 The new cells connected up

and negative connections to the cell stack. There should also be another insulating layer on the bottom of the case, check the condition of this and if it is at all damaged, it should be removed.

Lay five of the new cell stacks side by side and solder the tags together positive to negative (or if you are using individual cells you will have to make them up into inline pairs first). Tape them together then lay the other five on top and connect up in a similar manner. It is a good idea to place a

Fig 3. Test charging

piece of thin insulating material between the two layers, I use the clear plastic sheeting in which many things are packaged these days, but probably better would be thin fibreglass sheet

Fig.4 Final testing before the lid goes back on!

as in the original battery if you can get it (it is more heat resistant). The original battery relied only on the 'heatshrink' wrap of the cells for inter-cell insulation, as you can see in fig.1 this has not fared too well!
When the cells are all connected up it is a good idea to measure the terminal voltage – it should be very close to 24 volts unless the cells are totally flat. If it is any less, check for reversed cells, it is easy to do if you are not careful. When you are satisfied that the wiring of the cells is correct, place a piece of insulating material in the bottom of the battery case and ease the new cell pack into the case. Then slide a suitably sized piece of insulating material between the cells and the case on each side and on top. Relocate the sensor diode in the centre of the cell pack, and connect the red and black wires to the appropriate terminals of the cells. Refit the top metal cover but do not re-rivet it at this stage, a couple of self - tapping screws will locate it if it is loose.
Now is the time to charge the battery: give it a couple of hours, if the indicator lamp on the charger doesn't change over see if the cells are any more than just warm, if not give them a little longer, if they are quite hot you may have damaged one of the diodes; they can be checked for continuity with a multimeter, (see fig 5). If all is well clip the pack to your radio and see how long it works for! It may be necessary to charge and discharge new cells a few times before full capacity is achieved.
When you are quite sure the battery is working properly, remove the cover and add some more insulation as necessary to make sure the cells aren't loose. You can buy small cans of expanding foam from diy stores and builders merchants, but I would suggest not using this material unless you really want to make the pack 'squaddieproof', as sooner or later the cells will fail again!! Also, the foam is expensive and once a can is started, it 'goes off' very quickly and so is wasted, it's only an economical proposition if you are doing several batteries together. Either way, replace the cover, 'pop' in some new rivets and no-one will know its been apart.

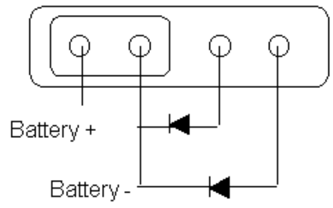

Fig.5 Charging socket connections